CHAPTER 26: SUGGESTIONS FOR SAVING FUEL IN STEAM-GENERATING PLANTS: POINTS TO CONSIDER

1- Lower the operating steam pressure in the boiler (or the water temperature in a hot water boiler) to the lowest possible level that still allows the steam to be used in the process.

Note that in some cases, lowering the boiler pressure may require reducing the maximum steam generation capacity, as this can disrupt internal circulation or introduce water carryover into the steam.

2- Use the burner (even with wood) as modulated as possible: in oil-fired boilers, use modulating burners or burners with alternating flames, regulating the lowest flame so that it doesn't go out as much as possible and ensuring that the highest flames don't exceed the maximum steam consumption (the response should be smooth).

When using wood, load it in short bursts, and regulate the air supply to prevent the boiler from shutting down due to high pressure, so that combustion matches steam production.

3- Place a thermometer in the chimney and try to keep the temperature as low as possible, periodically cleaning the heat transfer surfaces, especially the soot (or ash) on the hot gas side.

On the water side: perform a good chemical treatment, clean the sludge periodically, and keep the heat transfer surfaces free of scale by performing chemical and/or mechanical cleaning.

This temperature will be influenced by the combustion percentage, excess air, and operating pressure.

4- Keep excess combustion air to the minimum necessary

To prevent heating air that isn't being consumed), while still ensuring complete combustion.

In fuel oil, maintain a light caramel-colored smoke in the chimney, with an orange flame and slightly darker tips, indicating complete combustion before reaching the flue (CO_2 between 13% and 15%).

With firewood, smoke doesn't indicate combustion conditions, and flame observation is only feasible in direct combustion: the flame should reach halfway up the flue pipe, always filling the flue opening with flame (in tubular stoves).

In gas generators and gas stoves, flame observation is not a reliable guide; it's preferable to measure the gases.

In wood-burning stoves, the recommended CO2 level is between 14% and 16%, and O2 between 3.5% and 5.5%, since higher CO2 levels are generally accompanied by the presence of unburned gases.

Verify that the stove is on the excess air side by checking for the absence of CO (carbon monoxide).

Alternatively, measure the %CO2 and %O2 (oxygen) and use an Ostwald triangle.

In natural gas, observing the flame is difficult.

Try to measure the CO2% (around 10.5%) or the O2% (around 3%), but ensure there is no CO (or a maximum of 400 ppm).

5- Check the chimney for unburned gas leaks.

The presence of unburned gases is very common in wood and gas combustion, due to combustion problems or insufficient air.

In these cases, only measurement allows for detection.

This loss can be significant (up to 5-7% for every 1% of CO in chimney gases).

6- Improve fuel conditions.

Especially with firewood, try to burn wood with a low moisture content (22% to 25%) and in good storage conditions (not too old, rotten, etc.). It's worthwhile to maintain the log storage area.

7- Seal all air leaks that may enter the boiler but are not part of the combustion process.

Using a candle flame or a kerosene or diesel burner, check all the gaskets on the covers of the flue boxes or masonry to find air leaks (the candle flame is drawn towards the leak).

Seal these leaks with asbestos rope (a questionable material) or other suitable material.

These air leaks heat up and carry the heat through the chimney, appearing as excess air.

8- Adjust the negative pressure in the combustion chamber to the lowest possible value (in boilers with negative pressure).

Place a U-tube filled with water (glass, plastic, etc.) in the combustion chamber to measure the negative pressure.

The greater the negative pressure, the greater the air losses due to air entering from outside and through the combustion zone.

9- Improve the insulation of the boiler and its accessories.

Almost everything can be insulated to a certain extent. Asbestos is banned in most parts of the world today.

Other approved insulating materials exist that are safe for human health and the environment.

There are areas that should not be over-insulated, as this could lead to very high internal temperatures and potentially cause burns: refractory firebox walls, lids in areas with very hot gases, etc.

10- Control the amount of purge blowdown and use continuous blowdown, extracting the heat in a heat exchanger.

A percentage of continuous purge blowdown is always necessary.

Bottom and level purge blowdowns are necessary for safety and sludge removal.

Heat recovery from these purge blowdowns is difficult, but all the purging of dissolved salts can be done through continuous purge blowdown, easily extracting the heat in a heat exchanger (to heat the makeup water or for other purposes).

11- Recover as much return condensate as possible.

It is pure water, which reduces the need for blowdown.

It is hot water, requiring less heat to vaporize (if necessary, increase the height of the feed tank to prevent pump slippage - cavitation).

12- Recover flash steam.

Every kilogram of flash steam recovered is one kilogram less steam that the boiler needs to generate.

13- Insulate steam pipes, condensate pipes, fittings, and equipment that require heating.

The insulation must be of adequate quality and thickness, as well as the finish of its protective covering (sheet metal, fiberglass, material, etc.).

Fittings such as valves, regulators, etc., are areas of significant heat loss. They can be insulated with insulation blankets that are removed during repairs or maintenance.

The cheapest insulation is not necessarily the most economical.

14-Reduce the temperature and timing of processes as much as possible.

This will result in lower steam consumption.

15-Install control instruments: thermometers, pressure gauges, flow meters, etc.

These will allow for visual monitoring and the setting of limits for each case. (*NOTE)

16-Automate where possible.

Automation more effectively controls these usage limits for energy management, and with proper adjustment, allows for energy use tailored to the process needs.

17- Verify that the steam traps are appropriate and functioning correctly.

Steam traps should be carefully considered; the cheapest ones are sometimes the most expensive to run.

Each trap has a more convenient use, but nowadays the cost of use should be considered more than the initial cost.

Maintenance of the traps affects steam consumption. Some traps consume energy when operating: they are "wasteful."

18- Install condensate sight glasses on the traps.

Traps should be checked daily using sight glasses. If sight glasses are not installed, a check can be performed with a surface thermometer or a trap tester (acoustic or thermal).

19- Heat Exchangers.

These must be suitable for the intended use, as excessive time to achieve the desired effect, condensate loss, the need for higher pressures, etc., lead to greater losses.

20- The Installation Itself.

Pipes with inadequate layouts, unforeseen drops, excessive flat bars, etc., are also causes of heat loss.

21- Boiler Makeup Water Quality.

We should look for water with the lowest salt content, as this allows for less purge blowdown (saving heat and water), lower treatment costs (salt in the softener, internal chemicals), and fewer steam problems (due to salt decomposition).

Surface water (generally from OSE in Uruguay) is usually better than well water (which may seem cheaper to use).

22-Heat Recovery Systems.

Installing heat recovery systems can be an effective way to save energy: excess temperature in chimneys, wastewater, equipment vents, hot air or gas extraction systems, etc.

23-Operating Methods.

Whenever possible, operate with one boiler instead of two, two instead of three, etc. Keep the boiler operating at approximately 80% of its capacity, etc.

24-Design.

Many pieces of equipment (boilers, heat exchangers, etc.) were designed with criteria different from current standards (materials, construction, fuel cost, etc.). Sometimes, a new boiler or new piece of equipment pays for itself in just a few months through fuel savings.

25- Have the necessary handheld instruments for inspection.

Combustion gas meters, portable thermometers for immersion, surface use, etc., with training for the personnel involved. (*NOTE)

26- Training and awareness.

Raising awareness is fundamental to achieving energy savings, and for this, people must be trained: given the necessary knowledge and appropriate practical training.

In some cases, this may involve hiring people from outside the company (sometimes "no one is a prophet in their own land") with recognized expertise in the subject, who possess teaching skills and can capture people's attention.

(*NOTE) All instruments (analog/needle or digital/digital), in order for their readings to be considered "reliable measurements," must be periodically checked against a reference standard instrument (either owned by the industry o seller itself or from an independent calibration laboratory). Generally, low-cost instruments have significant precision/resolution and uncertainty, typically 10 to 20% deviation/error.

Expensive international-class or industrial-grade instruments exhibit precision and uncertainty on the order of 1 to 2%. Only commercial-grade measuring equipment used for billing purposes offers resolution/precision and uncertainties of Class 0.5 or Class 0.2. (0.2 to 0.5 % deviatio/error when checked to a standard reference laboratory instrument.

And always remember the safety of the personnel operating and maintaining the boiler. Use PPE correctly, in good condition, and up-to-date (not obsolete).

Gone are the days of working while committing unsafe acts.

Human life comes first; the equipment can be repaired.